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ORIGINAL

FINAL REPORT

GEOPHYSICAL SURVEYS TO INVESTIGATE SURFACE AND SUBSURFACE CONDITIONS AT THE ELKTON FARM FIREHOLE SITE ELKTON, MARYLAND

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION III
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FT. MEADE, MD 20755-5350

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CONTRACT NUMBER: EP-S3-05-02
TECHNICAL DIRECTION DOCUMENT: E03-001-05-10-003
DOCUMENT TRACKING NO. 0053

November 2, 2005

November 2, 2005

Mr. Charlie Fitzsimmons
On-Scene Coordinator
U.S. Environmental Protection Agency
Region III
701 Mapes Road
Ft. Meade, MD 20755-5350

Subject: **Final Report of Geophysical Surveys**
To Investigate Surface and Subsurface Conditions
At the Elkton Farm Firehole Site
Elkton, Maryland
TDD No. E03-001-05-10-003
DTN No. 0053

Dear Mr. Fitzsimmons:

Tetra Tech EM Inc. (Tetra Tech) is pleased to submit this final report of the geophysical surveys conducted for the above referenced property. The purpose of Tetra Tech's services was to perform detailed geophysical surveys to support the investigation and removal of contaminated soils containing waste sources including ordnance and explosive waste.

This report is intended for the sole use of the U.S. Environmental Protection Agency and its subsidiaries only. Our services have been performed under mutually agreed on terms and conditions. If other parties wish to rely on this report, please have them contact us so that a mutual understanding and agreement of the terms and conditions for our services can be established prior to their use of this information.

The findings and recommendations contained herein are based on previous data that were reviewed and documented in this report, our field reconnaissance and survey, and our experience on similar projects.

We appreciate the opportunity to be of service to you. Please feel free to contact myself or Mr. Parish if you have any questions or concerns.

Sincerely,

TETRA TECH EM INC.

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Project Manager
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Senior Geophysicist
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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA), Region III engaged Tetra Tech EM Inc. (Tetra Tech) to support the investigation and removal of contaminated soils containing Materials of Explosive Concern (MEC) waste material and other waste sources at the Elkton Farm Firehole Site, Elkton Maryland (hereafter referred to as the "Firehole Site"). The objective of this investigation was to better define the boundaries of the suspected Firehole area, and to provide an initial survey of the remainder of the Firehole Site to determine the presence of any other areas of potential concern.

Based on existing data, previous site clearance, and projected land use, Tetra Tech prepared a work plan (Tetra Tech 2005a) to serve as a scope of work for potential interactions with the U.S. EPA, the Maryland Department of the Environment (MDE), Tetra Tech, and future site contractors. In addition, the work plan was created to provide a technical approach to facilitate the investigation. This technical approach called for geophysical surveys to be conducted across the investigation area. The primary objectives of the geophysical surveys were as follows:

- Delineate and map the "footprint" of the suspected Firehole area
- Identify and map any other potential areas of concern
- Mark geophysical anomalies for future reacquisition in areas both directly impacted by the proposed investigation and removal activities of the suspected Firehole area, as well as any other areas identified as potential areas of concern

The geophysical surveys were conducted from May 9 through 23, 2005. Surveys were conducted using a Geonics® EM61-MK2 Time Domain Metal Detector (EM61) and Schonstedt® Magnetic Locator (Schonstedt). All work conducted during this investigation closely followed the procedures and safety protocol detailed in the health and safety plan (Tetra Tech 2005b).

The results of the geophysical surveys are presented in Section 6.0 of this report with recommendations for further actions presented in Section 7.0.

1.0 INTRODUCTION

Under Eastern Area Superfund Technical Assessment and Response Team (START) Contract No. EP-S3-05-02, Technical Direction Document (TDD) No. E03-001-05-10-003, the U.S. Environmental Protection Agency (EPA) Region 3 tasked Tetra Tech EM Inc. (Tetra Tech) to support the investigation and removal of contaminated soils containing munitions and explosives of concern (MEC) waste material and other waste sources at the Elkton Farm Firehole Site, Elkton Maryland (hereafter referred to as "the site" or "Firehole Site").

The objective of this investigation was to better define the boundaries of the suspected Firehole area, and to provide an initial survey of the remainder of the Firehole Site to determine the presence of any other areas of potential concern. To facilitate this investigation, Tetra Tech used geophysical survey instruments to detect the presence of surface and subsurface items of concern.

The site location, project objectives, and the report organization are discussed below.

1.1 SITE LOCATION

The Firehole Site is located approximately at 183 Zeitler Road (end of the road), Elkton, Maryland near the intersection of Routes 40 and 279 (Figure 1). The Firehole property occupies approximately 55-acres of the 400-acre Elkton Farm and is located just south of Zeitler Road between Little Elk Creek and Laurel Run.

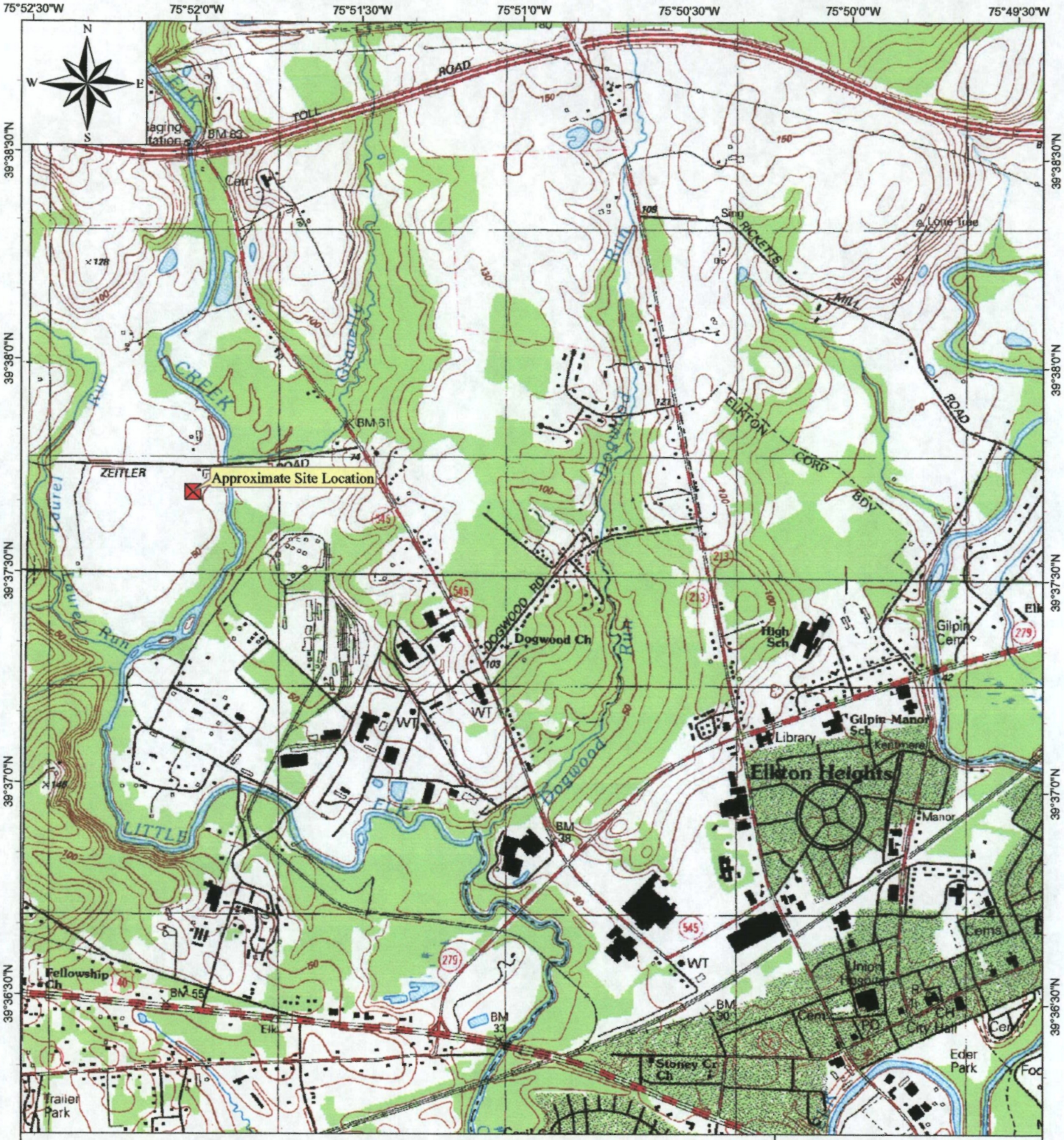
1.2 PROJECT OBJECTIVES

The primary objective of this project was to provide MEC safety oversight support for the investigation and removal of contaminated soils containing MEC waste material and other waste sources at the Firehole Site. To accomplish this objective, Tetra Tech conducted geophysical surveys to—

- Delineate and map the "footprint" of the suspected Firehole area
- Identify and map any other potential areas of concern

- Mark geophysical anomalies for future reacquisition in areas both directly impacted by the proposed investigation and removal activities of the suspected Firehole area, as well as any other areas identified as potential areas of concern.

With this information, U.S. EPA will be able to target specific areas of concern, estimate the total extent of potential contamination, and identify possible cleanup methods and technologies.



Source: Modified from USGS 7.5-Minute Series Topographic Quadrangles, Elkton, Maryland - Delaware, 1992; Newark West, Maryland - Delaware - Pennsylvania, 1992	0 0.25 0.5 Miles

Quadrangle Location = ■

Maryland

Elkton Farms

Elkton, Cecil County, Maryland

Figure 1

Site Location Map

TDD No. 001-05-07-021 EPA Contract No. EP-S3-05-02	Map created on November 2, 2005 by A. Felkel, Tetra Tech START	TETRA TECH EM, INC.

1.3 REPORT ORGANIZATION

This report consists of the sections summarized below.

- Section 1.0, Introduction, contains information about the site location, the project objectives, and organization of this report.
- Section 2.0, Historical Perspective, discusses former site and surrounding property usage, as well as site-related information from previous environmental reports.
- Section 3.0, Survey Approach, provides details about the survey equipment and survey approach.
- Section 4.0, Data Acquisition, presents specifically how the data were gathered.
- Section 5.0, Data Processing and Interpretation, discusses data processing and interpretation.
- Section 6.0, Results, summarizes survey results.
- Section 7.0, Concluding Remarks, provides a final statement from Tetra Tech.

References used to prepare this report are presented at the end of the text. In addition, this report contains the following appendices.

- Appendix A presents a Photo Log illustrating site activities, geophysical equipment and procedures.
- Appendix B presents three geophysical survey data presentation maps.

2.0 HISTORICAL PERSPECTIVE

This section provides an historical perspective for the former site and surrounding property uses and summarizes information from previous environmental reports.

The most recent use of the site has been as a working farm. During the decade before and during World War II, the parcel had been the site of activity related to the manufacture of fireworks and munitions. For a brief period between 1943 and 1947 the property was impacted by military operations.

After being identified as a potentially responsible party, the U.S. Army Corps of Engineers contracted with TechLaw, Inc. to perform an investigation of the site operations and ownership history of the Firehole Site. The owner at that time was Triumph Explosives, Inc. (TEI). In February 1992, the final report for this project was prepared by TechLaw, Inc. This report identified an area on the current Elkton Farm as the Firehole. The Firehole was documented as an area for the disposal of waste explosives material. This waste was reportedly collected in drums and kept wetted with alcohol or ether. This waste was then carried to a shallow pit off Zeitler Road, spread thinly and allowed to burn. Plant personnel monitored the burn until the waste explosive was ostensibly consumed.

The total quantity of hazardous waste disposed of in the Firehole is unknown. There is no estimate of fill thickness for the Firehole. A geophysical survey conducted for the Maryland Department of the Environment (MDE) by NAEVA Geophysics, Inc. (NAEVA) indicated several distinct anomalies on the portion of the property east of Laurel Run and south of Zeitler Road. Observations indicate that the Firehole is not one discrete area but rather a series of burn pits located across the property in an approximate 32-acre area.

The Firehole was reportedly the subject of a cleanup that saw the removal of tens of tons of contaminated soil. According to two separate sources, Mr. Patrick Herron and Mr. Richard Herron, soil was removed from an area where crops would not grow, and clean soil was brought in to fill the excavation. The removed soil was said to have contained scraps of brass shell casing and metallic slag.

A sampling and analysis plan to characterize the 32-acre site was prepared by MDE after site reconnaissance and a review of available historic information of the area. On October 10 to 11, 2002, as part of the Formerly Used Defense Site (FUDS) Inspection, MDE collected 14 surface soil samples, 10 subsurface soil samples, 6 surface water samples and 6 sediment samples. The samples were analyzed for the presence of metals and cyanide, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), pesticides and polychlorinated biphenyls (PCBs), perchlorates and nitroaromatic compounds. On May 21, 2003, to finalize data collection for the FUDS Inspection, MDE collected five groundwater samples and had them analyzed for the presence of total and dissolved metals, VOCs, SVOCs, pesticides and PCBs, nitroaromatic compounds, and perchlorates.

A toxicological evaluation was prepared for the Firehole Site, assuming a residential future use scenario for the site. The EPA recognizes an acceptable hazard index of values less than or equal to 1 (noncarcinogenic chemicals) and a lifetime cancer risk less than or equal to 10^{-6} to 10^{-4}. MDE recognizes threshold hazard index values equal to 1 and lifetime cancer risk threshold values less than or equal to 1×10^{-5}. Risk estimates exceeded EPA and MDE recommended levels for the child resident population for incidental ingestion of and dermal contact with surface soils, with the risk drivers of potential additive effects, chromium, and arsenic. Concentrations detected exceeded the EPA and MDE recommended levels for ingestion of and dermal contact with subsurface soil for the child resident, with the risk drivers of potential additive effects and chromium. Lead was detected at 1,480 milligrams per kilogram, which may pose a threat to sensitive populations and the environment. Risk for the incidental ingestion of and dermal contact with groundwater exceeded MDE and EPA recommended levels for all residential populations, with trichloroethene (TCE) as the risk driver.

Samples were collected in the area defined by the NAEVA geophysical survey as the most likely area of the Firehole. Sample analysis showed elevated concentrations of lead, mercury, and arsenic, as well as TCE and PCBs (Aroclor 1254), and the nitroaromatic compound Trinitrotoluene (TNT) and associated daughter products. Subsurface soil samples from the Firehole area were not collected because of refusal at less than 18 inches. Samples obtained from the vicinity of the former Thiokol Motor Recovery Area (TMRA) and midway between the Firehole and TMRA also exhibited elevated levels of several explosive compounds.

The Elkton Farm property is currently listed for sale on the real estate market. It is also currently leased to Spry Brothers Farming for seasonal crops; however, in all likelihood, the entire 400-acre farm will be developed for residential use in the future, rather than continued use for farming. The presence of TNT and daughter products, elevated concentrations of metals, highly volatile TCE detected in surface soils and groundwater, and the presence of ordinance-related debris easily observable on the ground surface all suggest that further investigation is necessary in order to fully identify any human health risks to future residential populations.

3.0 SURVEY APPROACH

The geophysical surveys were conducted from May 9 through 23, 2005. Surveys were conducted using a Geonics® EM61-MK2 Time Domain Metal Detector (EM61) integrated with a Trimble AgGPS® 132 Differential Global Positioning System (GPS) Receiver. A Schonstedt® Magnetic Locator (Schonstedt) was also used for various tasks.

This section provides information about the use of these systems at the site. The following subsections include an overview of the systems, equipment standardization, testing and evaluation (prove out), and quality control and quality assurance procedures. Pictures illustrating the geophysical systems and associated testing are provided in Appendix A.

3.1 GEOPHYSICAL SURVEY OVERVIEW

A brief description of the various geophysical systems used at the Firehole Site is provided below.

3.1.1 Geonics® EM61-MK2 Time Domain Electromagnetic Metal Detector

The EM61 has been used for more than 10 years to detect subsurface metal objects. It is one of the most widely accepted methods of subsurface metal detection. The system consists of two coils mounted on a non-metallic wheeled cart at about 16 and 32 inches above the ground surface, respectively. The most common coil configuration is a 1-meter by one-half meter rectangle, although other sizes are also used.

The physical principle employed is electromagnetic induction where the transmitter coil, which is coincident with the bottom receiver coil, emits a pulsed electromagnetic field into the ground, inducing eddy currents in nearby metallic objects. The eddy current decay produces a secondary magnetic field that is sensed by the two receiver coils of the EM61 system. The EM61 receiver coils collect this data over four (decay) time gates. The earlier time gates (Gates 1 and 2) are particularly effective in detecting secondary fields from smaller, shallow objects, due to their relatively quick decay rates, while increasing the maximum depth of detection for all targets, due to the increase in response amplitude. Gate 3 is the standard, mid-range time gate that was used in the older EM61 models used to detect a broad range of target sizes and depth ranges. Gate 4, the late time gate, will detect the presence of larger objects while effectively filtering out the smaller, near surface targets. Additionally, a differential data calculation is performed, which is the difference between the Gate 3 top and bottom coil data. It is designed to remove or reduce the effects of noise associated with surface or near-surface metal, and better differentiate larger and deeper targets. It is also used to provide a depth estimate to point source targets. Gate 4 was not used for this investigation because the differential calculation data provide much the same information.

The four time gates, or time gates 1 through 3 and the differential calculation data (operator's choice) are stored in the data logger along with the position of the measurement, as collected by the GPS receiver. Generally, peak voltage intensities are centered over metallic objects, greatly simplifying interpretation. One important feature to consider when using the EM61 is that this instrument detects all types of metal.

3.1.2 Schonstedt® Magnetic Locators

The Schonstedt is an analog magnetic detector that is highly portable, and can be operated by one person. The instrument emits a steady audible tone in areas where no anomalies are present. The audible tone increases when the instrument senses a magnetic feature. The Schonstedt can be used in areas inaccessible to the other geophysical systems because of its portability. In addition, the Schonstedt is used by MEC technicians to pinpoint the location of potential ordnance items in the field.

3.2 GEOPHYSICAL INSTRUMENT PROVE OUT

At the onset of geophysical surveys at the site, an instrument prove out was conducted. This instrument prove out was used to —

- Provide information about the effectiveness of the instrumentation over the site
- Provide documentation about the anomaly signature from each instrument over known objects
- Provide a location for daily standardization of equipment prior to the beginning of the survey
- Provide quality assurance that the instruments were tested and are functioning in a standard manner.

A prove out area was selected within the outlined survey area, and a baseline survey was conducted with each instrument. Prior to the survey, visible metal was removed from the area. The size of this area was approximately 50 feet long by 10 feet wide, and was representative of current site conditions. Following the baseline surveys, simulated items of the size expected to be found on the site were emplaced. Five objects were emplaced at various depths across the prove out area. Three 2-inch diameter steel ball hitches were buried at 6, 12, and 24 inches below the ground surface, respectively. Two 6-inch steel hitch pins were also buried at depths of 6 and 12 inches below the ground surface. The locations were determined using the baseline data to avoid existing anomalies and were placed generally along a line that could be surveyed on a daily basis for equipment standardization following prove out analysis. Pictures showing the geophysical prove out operations are presented in Appendix A.

Following a successful prove out of the geophysical systems, these data were evaluated and archived for comparison during subsequent daily equipment standardizations. The data was used as part of the geophysical survey quality assurance and quality control procedures discussed in Section 3.3. The EM61 was the primary instrument used for the surveys.

3.3 GEOPHYSICAL SURVEY QUALITY ASSURANCE AND QUALITY CONTROL

As part of the quality assurance and quality control of geophysical systems data, a number of operations were conducted on a daily basis. These quality assurance and quality control operations were used to verify geophysical system parameters, including stability of system response, data repeatability, equipment function, location accuracy, and operator interference. These parameters were evaluated on a daily basis using a checklist, and all quality assurance and quality control operations were documented in the project log book. The parameters are presented in the following sections.

3.3.1 Stability of System Response and Function

At the beginning of each day, and during occasions when equipment systems were exchanged or altered, the following tests were conducted. The geophysical instruments were operated in a designated anomaly-free area, within the standardization area, in a static position. System functions were checked to verify acceptable battery levels, system noise levels, and baseline leveling. A warm-up period of at least 4 minutes was implemented prior to the test, and data were then collected for a period of 2 minutes. These data were monitored and archived. If the systems response for the EM61 measurements were determined to be within the standard values and variations determined during the equipment prove out, the system was deemed ready for the daily geophysical survey. If the equipment responses were outside of the acceptable levels, the equipment was checked, repaired, or replaced. These specifications were reviewed by the project field manager and project geophysicist for accuracy and completeness during the equipment testing.

3.3.2 Operator Interference

At the beginning of each day, the clothing, footwear, and accessories were checked by the operator for magnetic properties and metallic content. This was verified by having the survey team monitor the equipment operator in a location at the standardization area that was determined to be free of anomalies and interferences. One team member held the instrument in a stationary position while the other team member approached the system from a minimum of two directions. The measurements were monitored for variance. If a variance was observed in the digital measurements outside of an acceptable level, it was documented during the equipment standardization, the team member was inspected for metallic objects, and then the field crew repeated the procedure until a minimum acceptable measurement threshold was reached.

3.3.3 Data Repeatability and Positioning

At the beginning of each survey day, the geophysical system was operated along the equipment standardization line to verify repeatability of measurement and location of anomalies. Additional tests were conducted in areas where known metallic objects had previously been surveyed and archived, including monitoring wells, survey monuments, and other man-made features, such as manholes and utilities.

These procedures were conducted on a daily basis, checked for accuracy and repeatability, and archived by the field team leader or project geophysicist. If abnormalities were discovered, corrections were made and the process was repeated as deemed appropriate.

4.0 DATA ACQUISITION

Tetra Tech began geophysical survey activities on May 9, 2005. Initial activities included familiarization of the proposed survey area and preliminary flagging/boundary marking. The initial geophysical investigation was to cover approximately 32 acres of farmland consisting of a relatively flat field, planted with wheat. While conducting preliminary survey operations, it was determined that a geophysical investigation across a larger area was necessary to assess site conditions. The U.S. EPA requested that Tetra Tech conduct geophysical surveys over an additional 25 acres, bringing the total area surveyed to approximately 57 acres. The entire geophysical survey coverage area is illustrated in Appendix B.

Weather conditions were variable during survey operations, and the geophysical surveys were conducted during days when weather conditions were favorable for optimum data collection, accuracy, equipment protection, and safety. Over the 15-day data collection period, 2 days were lost due to inclement weather.

The geophysical survey team consisted of a project geophysicist, who also served as site team leader; a site geophysical technician; and a site MEC technician. A minimum of one MEC qualified technician and one project geophysicist was on site during all geophysical surveys. The site geophysical team leader reported daily activities to the project manager, and also assured that all geophysical data were collected to meet the highest possible level of accuracy and completeness.

Wherever possible, surface metal and any other man-made interference were removed from the survey area prior to the geophysical survey. It was determined that the removal of existing vegetation was not necessary.

In all cases, areas that could be accessed safely were surveyed with digital geophysical equipment. Due to safety concerns and many large cultural interferences, the former Thiokol Motor Recovery Area (see Appendix B) was bypassed until further demolition and cleanup operations are completed.

Because of its large size, the Firehole Site was broken into smaller survey areas to facilitate better data management and ensure full coverage of the entire area. Prior to the survey, the Tetra Tech team set up 200-foot by 200-foot grids across the entire survey site. Each grid corner was marked with a red survey flag that was labeled with predetermined ground-based coordinates. This grid system was used to enable the geophysical survey crew to cover the entire survey area in a thorough and systematic manner. In addition, this allowed the data collected daily to be merged into a composite map covering the entire geophysical study area.

After the survey grid was established, the Tetra Tech team surveyed the area using measuring tapes and traffic cones to guide the instrument operator along 3-foot survey lines between the 200-foot markers. To conduct the initial survey grids, the geophysical operator carried the EM61 backpack containing electronics, the data logger, and the GPS system while pulling the wheeled cart over the terrain. As the height of the wheat crop grew taller, it became increasingly difficult to complete the survey grids. In order to cover the rest of the survey area in a safe and effective manner, an all terrain vehicle was used to pull the EM61 cart. Pictures of both geophysical collection systems are provided in Appendix A.

The EM61 data were collected at 0.1-second intervals, which when combined with the velocity of the operator, results in a reading approximately every 5 to 6 inches along the survey lines.

At the end of each survey day, the EM61 data were downloaded to a computer and processed. The data processing operations are discussed in Section 5.0, and will include details about geophysical map production and anomaly selection.

5.0 DATA PROCESSING AND INTERPRETATION

Digitally recorded geophysical data collected over the site were transferred from the data logging devices to a computer each day. The data from the geophysical surveys were processed daily by the senior geophysicist and was checked for accuracy, completeness, and potential entry errors. Each data set was pre-processed using Geonics® DAT61MK2 software to integrate the GPS data, and then entered into Geosoft Oasis Montaj® (Geosoft) data processing software to generate contour, color-fill maps indicating the intensity of the measurements from the geophysical systems. These data are displayed using a consistent range of color for visual display. All contour maps are oriented to a coordinate system designated by U.S. EPA to be consistent with existing map files for ease of interpretation. These maps are provided in Appendix B as Figures B-1, B-2, and B-3.

Final geophysical contour maps were generated using a licensed Geosoft UX-Detect® extension package that provides unique capabilities for locating and analyzing MEC targets. Using the Geosoft UX-Detect® software, the geophysicist can quickly locate the ground position of potential MEC targets and narrow these selections to a final target list.

The initial scope of work for this investigation called for Tetra Tech to reacquire and flag all suspected ordnance locations, as identified using the Geosoft UX-Detect® software. As the resulting contour maps were created; however, it became apparent that given the large number of potential anomaly locations identified across the site, this operation would have been extremely time consuming and prohibitively costly. Recommendations for further investigative actions are presented in Section 7.0 of this report.

The geophysical contour maps and tables will be used to relocate anomalies that require investigation, and identify areas that are free of anomalies resulting in footprint reduction of the areas of concern for MEC. The final presentation of the data is designed so that the U.S. EPA, MDE, assigned contractors, and the MEC safety oversight personnel can readily identify areas of concern.

6.0 RESULTS

Three final maps that illustrate interpretations of the data collected in the survey area are presented in Appendix B. Data collected with the EM61 system from Gate 1 (Figure B-1), and Gate 3 (Figure B-2), as well as the differential calculation (Figure B-3) are presented as individual composite maps of all the individual survey grids collected across the investigation area. The color contours represent the Geosoft processed data as a typical response value, as detected with the EM61. The unit of measurement of the typical response is millivolts.

Gate 1 data, the earliest time gate (216 microseconds), were used to improve the detection of the smaller, shallower targets, while improving the depth of detection of all targets. Analysis of the Gate 1 data and map (Figure B-1) indicates a large amount of shallow, metallic material located in and around the Firehole area. Two large trench-like areas are apparent, along with other areas of high concentrations of metallic material. Outside the Firehole area, metallic material is evident in various concentrations throughout the investigation area.

Gate 3 data (660 microseconds) were used to effectively filter out smaller, near surface targets that may not be of interest to the investigation, as well as low level noise, while detecting point-source (single) targets over a range of sizes that may be more characteristic of ordnance. The Gate 3 data and map (Figure B-2) confirm the presence of most of the metallic material evident in the Gate 1 data. However, much of the smaller anomalies and noise that were apparent in the Gate 1 data are not apparent in the Gate 3 data. The trends in the distribution of point-source anomalies are more apparent, especially in the east-central area of the map.

The differential calculation data, which is the difference between the top coil data and bottom coil data (both with decay times of 660 microseconds), were used to better discriminate larger targets, such as the "footprint" of the suspected Firehole area. Many of the metallic materials evident in the Gates 1 and 3 data are not present in the differential data and map (Figure B-3), but the larger targets sizes and shapes are better defined. For example, the two trench-like areas inside the Firehole Area are more prevalent and better defined as compared to the other data sets, as are the other areas nearby.

7.0 CONCLUDING REMARKS

The interpretation of the data clearly shows a very high number of anomalies present throughout the entire survey area, (55 acres within the Firehole Site). By using two time gates and the differential calculation data, target discrimination and definition was greatly improved, enabling the investigation goals to be met or exceeded. Two large, trench-like areas running north to south are prevalent in the northwest section of the survey area. This is consistent with the suspected Firehole location from historical data and previous investigations. An area of heavy contamination continues moving generally south and east for several hundred feet from the suspect Firehole area as well, with apparent trends of concentration tapering off from the east-central portion. Additionally, several smaller pockets of contamination and individual anomalies are scattered throughout the remainder of the survey area. The data from the eastern and southern portions of the survey area show a general decrease in the concentration of anomalies encountered; however, there are no areas presently identified by the survey that could be declared clear of anomalies.

Historical data indicates a substantial concentration of MEC was disposed of as part of the normal site activities. This MEC is readily identifiable during visible observations of the site and a risk assessment conducted at the site by Tetra Tech for U.S. EPA indicates an extremely high risk to personnel and property due to the presence of this material. Without further investigation, it is impossible to tell with certainty that the subsurface anomalies encountered during the geophysical survey are MEC. However, the signal strength of the anomalies encountered throughout the site is consistent with the expected output from the items described in the available historical data. It is also consistent with the MEC items visually observed at the site. Based on the available information, Tetra Tech has concluded that a majority of the anomalies encountered are most probably MEC related, and that further investigation and removal actions are required for the Firehole Site.

Tetra Tech recommends the following actions be implemented at the Firehole site:

- Immediate cessation of intrusive farming activities in and around the Firehole area to the extents of the existing geophysical survey
- Expand the geophysical survey area to accomplish a full delineation of the suspected MEC contamination

- Detailed data processing and presentation of individual grid maps to better discriminate noise from target and to aid in planning intrusive investigations.
- Excavate and sift several test grids in areas of lower anomaly concentrations to positively identify the contamination as MEC and better determine the depth of the contamination
- A full MEC removal action and environmental restoration of the suspect Firehole and other possible MEC areas identified by the geophysical survey.
- An after-action quality assurance/quality control geophysical survey conducted over a minimum of 10 percent of the affected land area to evaluate the success of the removal action implemented

The Firehole Site presents an immediate MEC and environmental hazard to the people who work and live in proximity to Elkton Farm and to the surrounding communities. It is recommended that the suggested actions be implemented as soon as possible and that they be followed through to their completion prior to the resumption of normal activities at and around the Firehole Site.

REFERENCES

Maryland Department of the Environment (MDE). "Sampling Plan for FUDS Investigation Elkton Farm". Waste Management Administrator. Baltimore, Maryland 21230. November 2, 2005.

NAEVA Geophysics Inc. "Results of Geophysical Investigations, Former Triumph Explosives Facility, Zeitler Road, Elkton, Maryland"; Charlottesville, Virginia; July 15-16, 2004.

NAEVA Geophysics Inc. "Results of Geophysical Investigations, Former Triumph Explosives Facility, Zeitler Road, Elkton, Maryland"; Charlottesville, Virginia; July 16 - 19, 2002.

Tetra Tech EM Inc. (Tetra Tech). 2005a. "Work Plan, Geophysical Survey, Elkton Farm Firehole, Elkton, Maryland." April.

Tetra Tech. 2005b. "Draft Health and Safety Plan, Elkton Farm, Firehole Site (MD433), Elkton Maryland." February.

APPENDIX A

Photolog

Photograph No. 1 **Location:** Elkton, Maryland
Orientation: Down **Date:** May 10, 2005
Description: 2-inch ball hitch to be buried in geophysical instrument prove out area.

Photograph No. 2 **Location:** Elkton, Maryland
Orientation: Down **Date**: May 10, 2005
Description: 6-inch hitch pin to be buried in geophysical instrument prove out area.

Photograph No. 3 **Location:** Elkton, Maryland
Orientation: Southeast **Date:** May 10, 2005
Description: Geophysical prove out area.

Photograph No. 4 **Location:** Elkton, Maryland
Orientation: South **Date:** May 10, 2005
Description: Burying 2-inch ball hitch to depth for geophysical prove out activities.

Photograph No. 5 **Location:** Elkton, Maryland
Orientation: Northeast **Date:** May 11, 2005
Description: Collecting geophysical survey data by pulling EM61-MK2 instrument through wheat field.

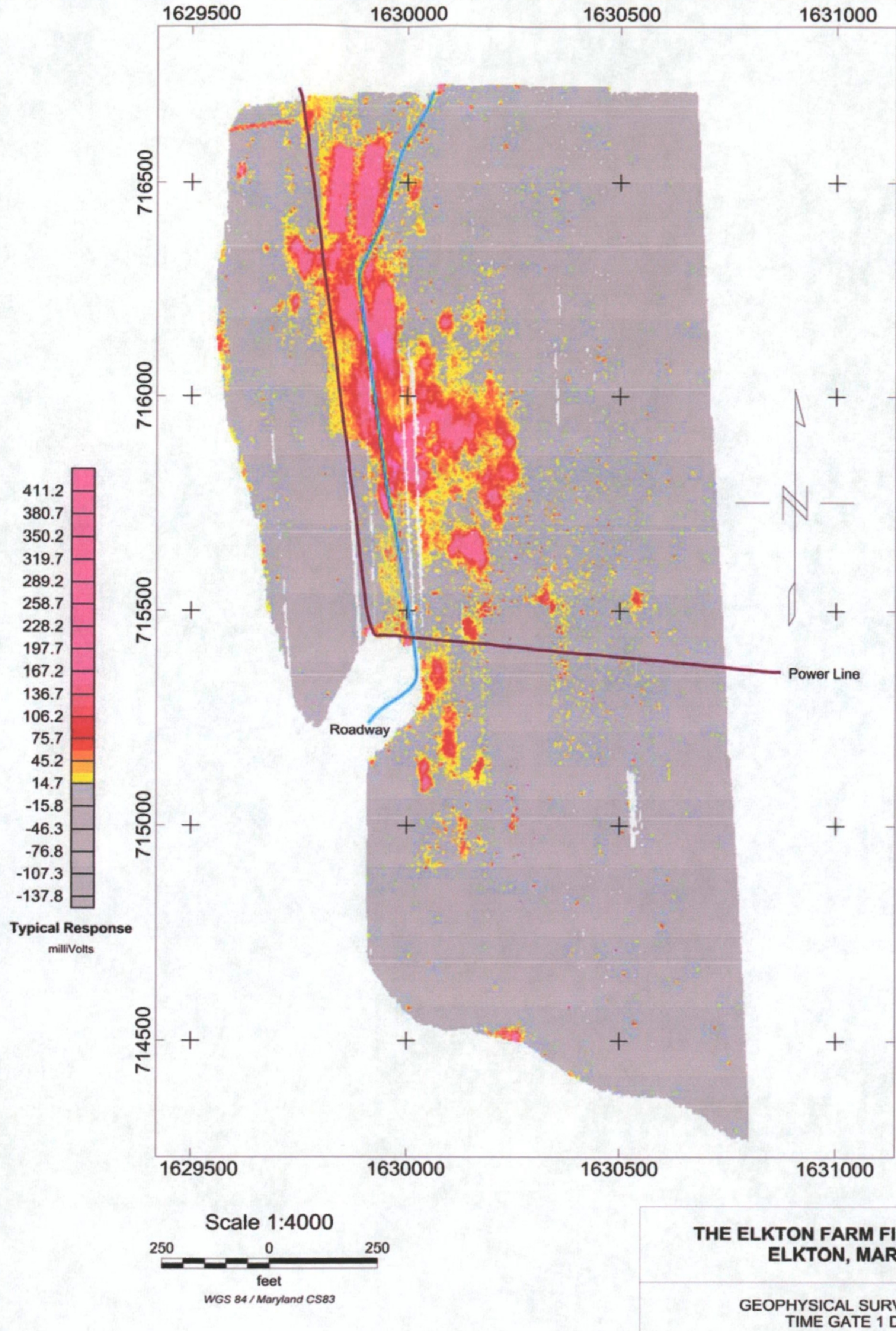
Photograph No. 6 **Location:** Elkton, Maryland
Orientation: Southeast **Date:** May 16, 2005
Description: Mounting system for all-terrain vehicle used to pull EM61-MK2 instrument.

Photograph No. 7 **Location:** Elkton, Maryland
Orientation: Northeast **Date:** May 16, 2005
Description: Alternate view of the all-terrain vehicle/EM61-MK2 system used to collect geophysical survey data.

Photograph No. 8 **Location:** Elkton, Maryland
Orientation: East **Date:** May 16, 2005
Description: Collecting geophysical survey data using all-terrain vehicle/EM61-MK2 system.

APPENDIX B

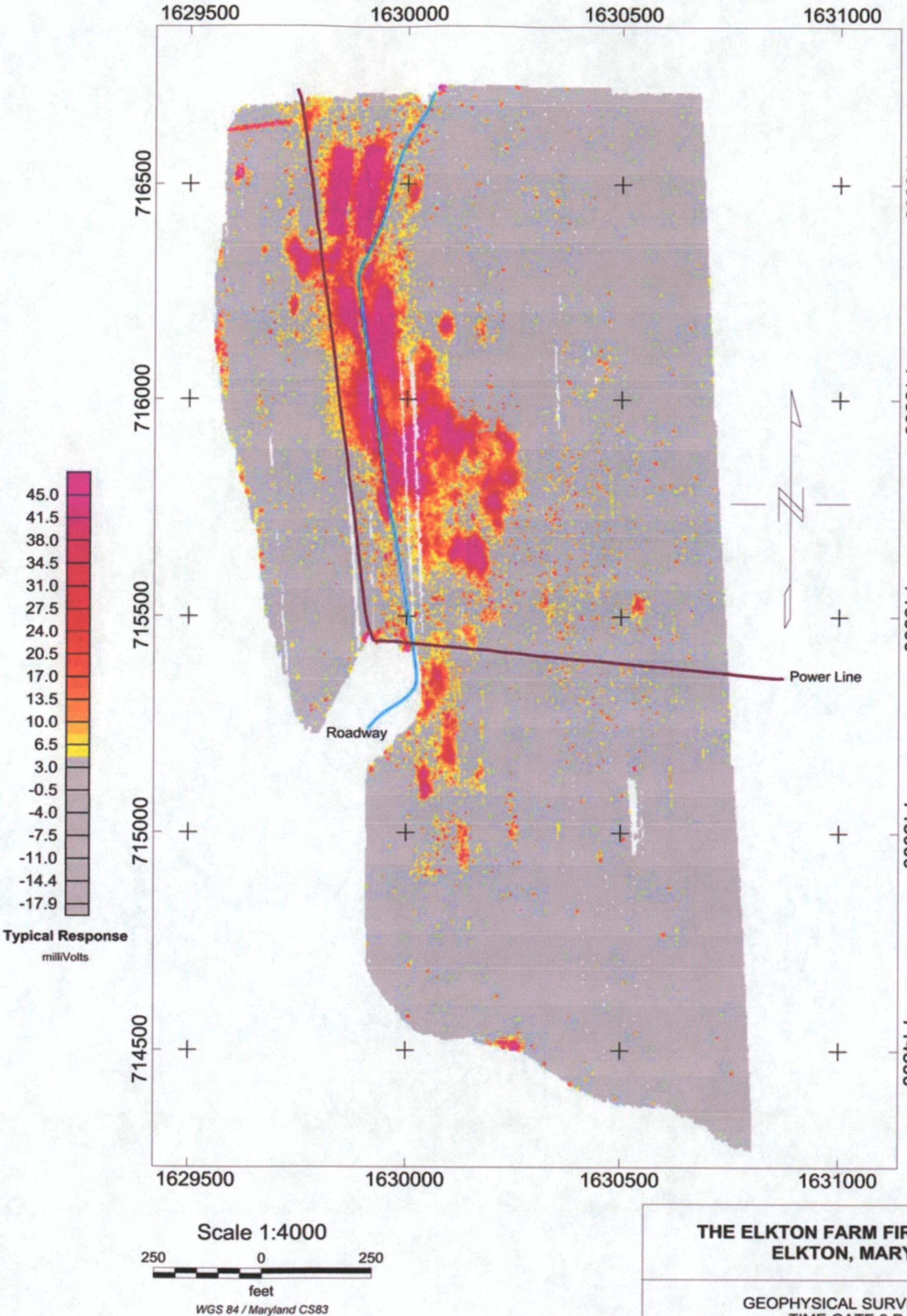
GEOPHYSICAL SURVEY DATA PRESENTATION MAPS



THE ELKTON FARM FIREHOLE SITE
ELKTON, MARYLAND

GEOPHYSICAL SURVEY RESULTS
TIME GATE 1 DATA

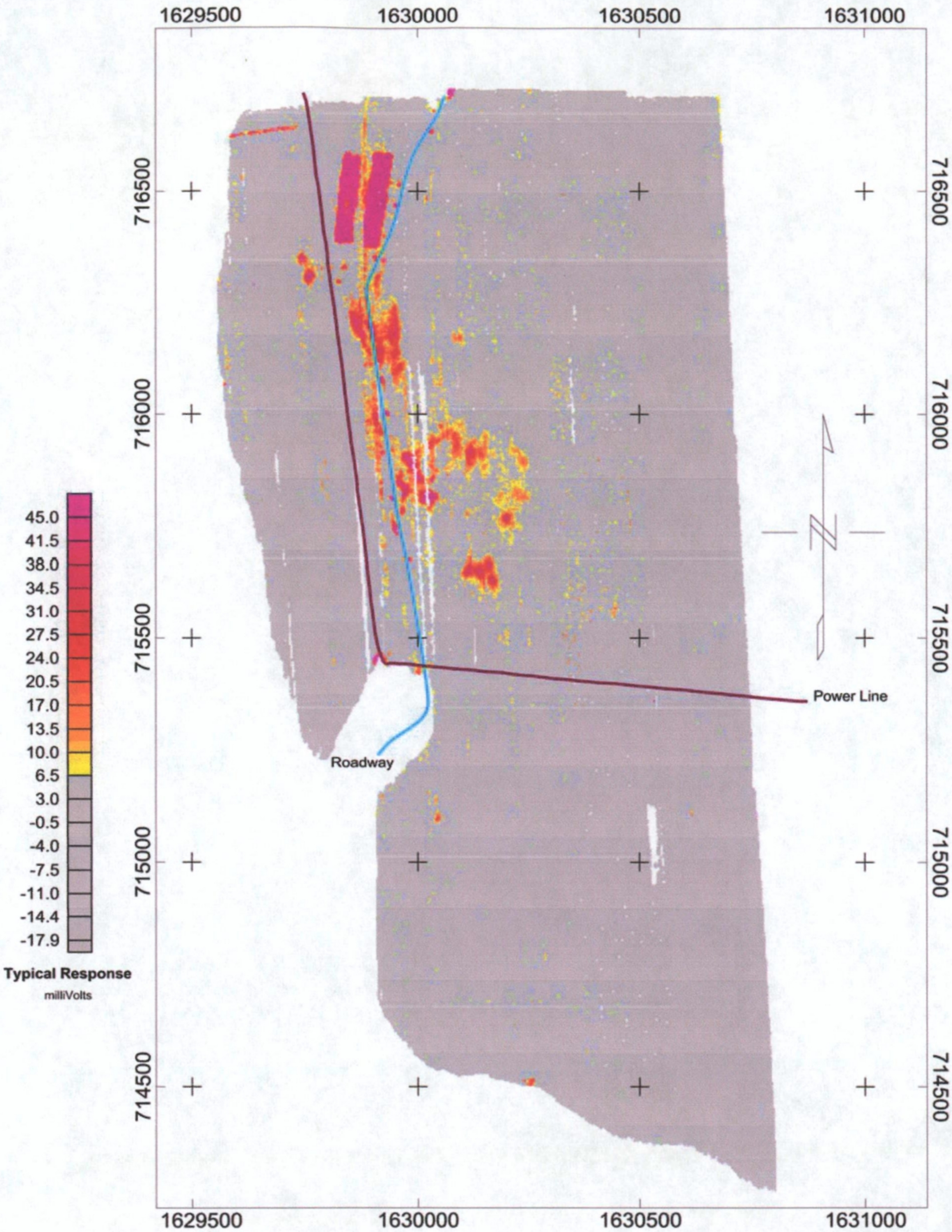
Tetra Tech EM Inc.



THE ELKTON FARM FIREHOLE SITE
ELKTON, MARYLAND

GEOPHYSICAL SURVEY RESULTS
TIME GATE 3 DATA

Tetra Tech EM Inc.



Scale 1:4000

250 0 250

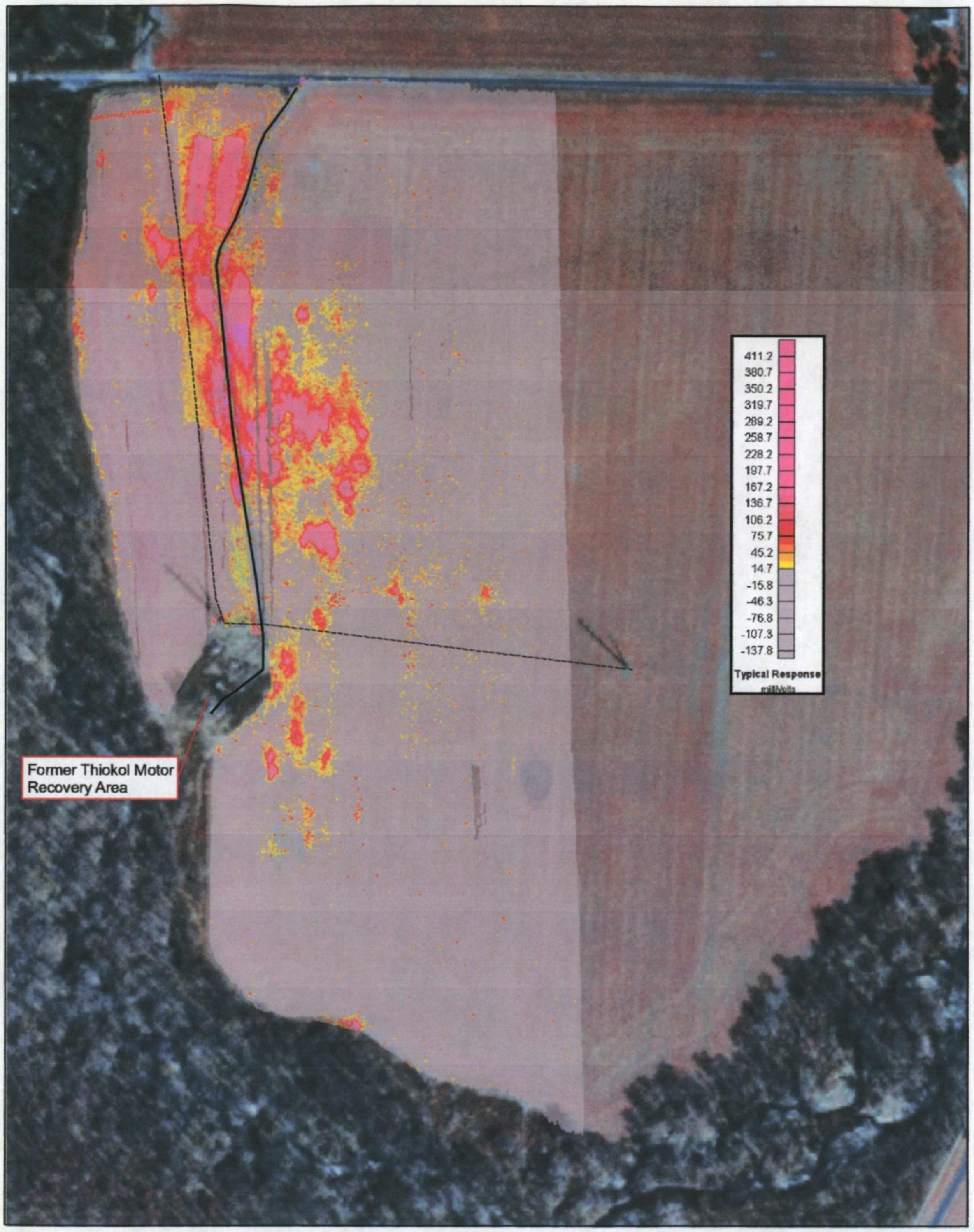
feet

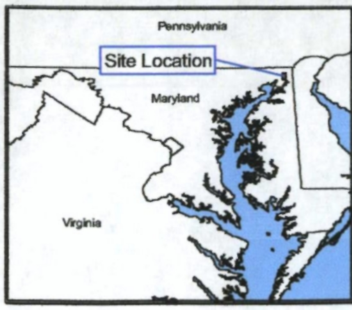
WGS 84 / Maryland CS83

THE ELKTON FARM FIREHOLE SITE
ELKTON, MARYLAND

GEOPHYSICAL SURVEY RESULTS
DIFFERENTIAL DATA

Tetra Tech EM Inc.





Road

Power Line

N W E S

0 120 240

Feet

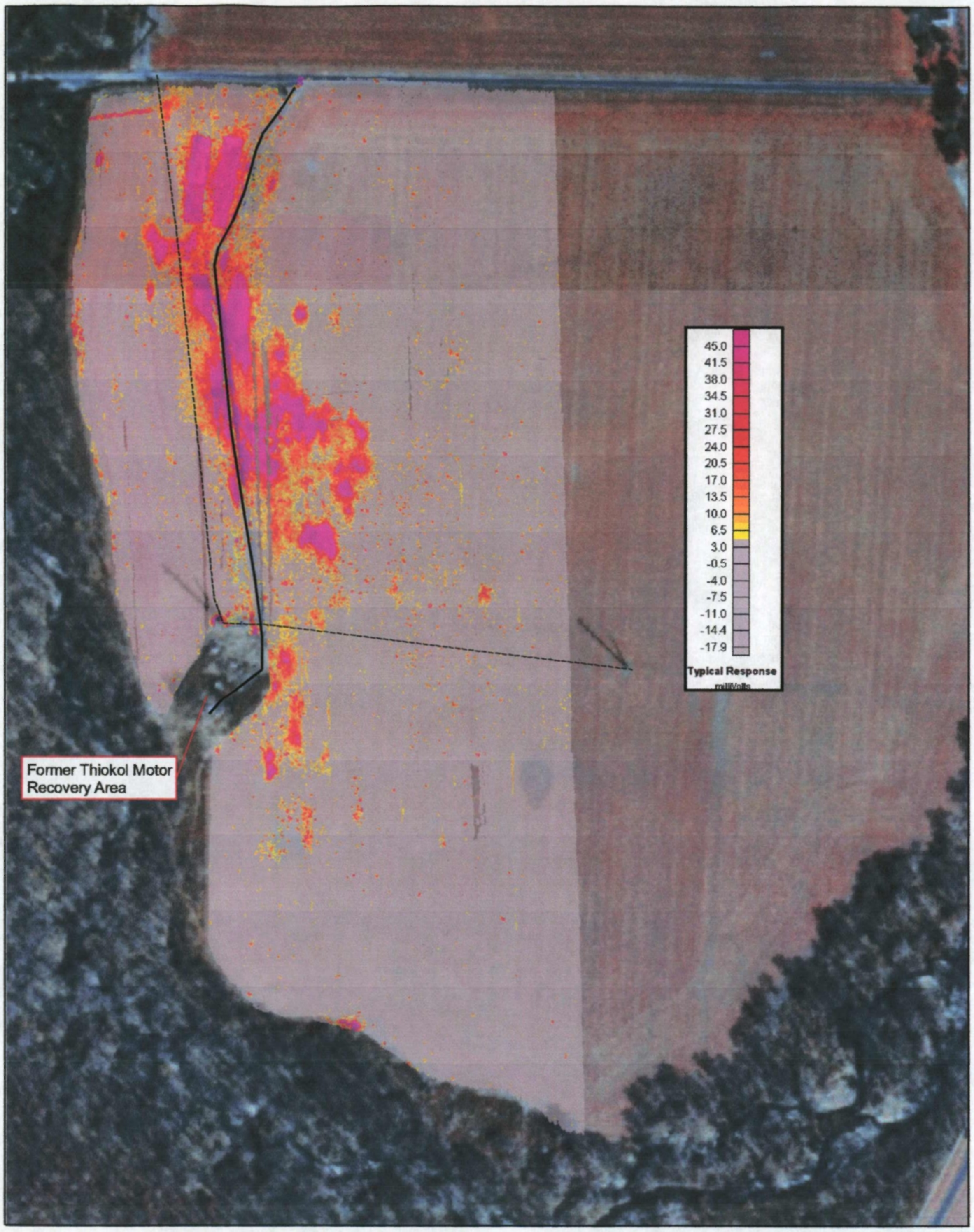
SOURCE: MODIFIED FROM MD DNR, NEWARK SOUTHWEST, MARYLAND QUADRANGLE, 1988.

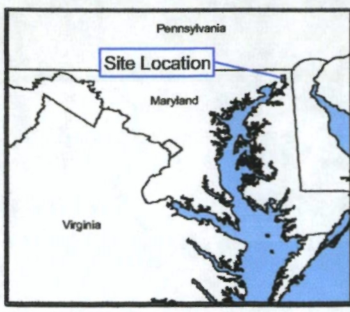
THE ELKTON FARM FIREHOLE SITE ELKTON, MARYLAND

FIGURE B-1
GEOPHYSICAL SURVEY RESULTS
TIME GATE 1 DATA

Tetra Tech EM Inc.

2005-06-28 s:\cadd\elkton\elkton b-1.mxd TTEMI-NV andrew.dye





Road

Power Line

N
W E
S

0 120 240
Feet

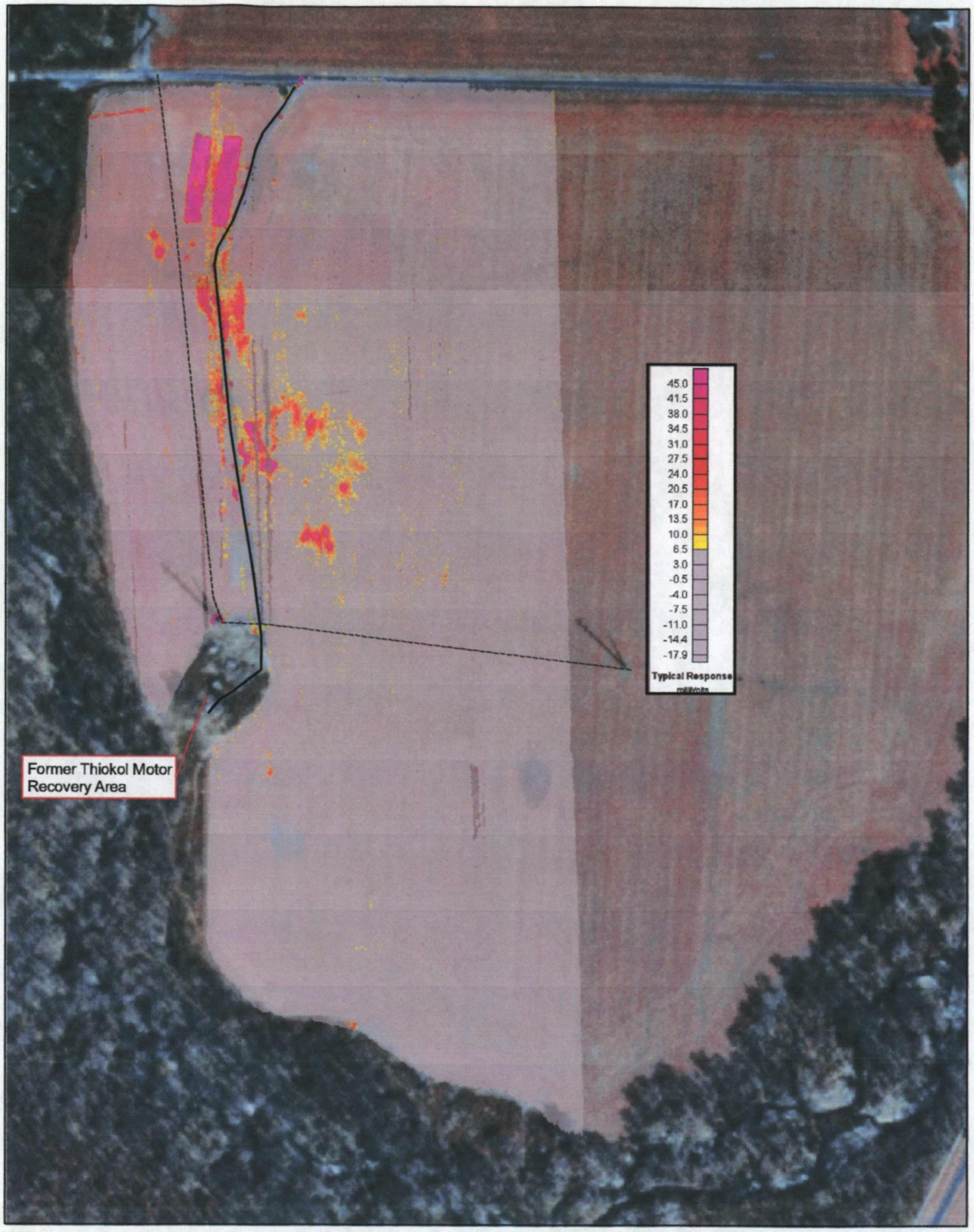
SOURCE: MODIFIED FROM MD DNR, NEWARK SOUTHWEST, MARYLAND QUADRANGLE, 1988.

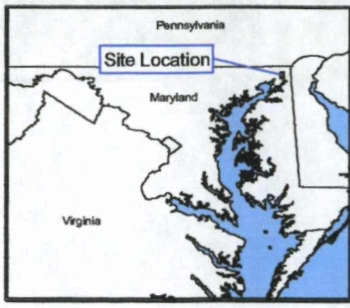
THE ELKTON FARM FIREHOLE SITE
ELKTON, MARYLAND

FIGURE B-2
GEOPHYSICAL SURVEY RESULTS
TIME GATE 3 DATA

Tetra Tech EM Inc.

2005-06-28 s:\cadd\elkton\elkton b-2.mxd TTEMI-NV andrew.dye





Road

Power Line

N
W E
S

0 120 240
Feet

SOURCE: MODIFIED FROM MD DNR, NEWARK SOUTHWEST, MARYLAND QUADRANGLE, 1988.

THE ELKTON FARM FIREHOLE SITE
ELKTON, MARYLAND

FIGURE B-3
GEOPHYSICAL SURVEY RESULTS
DIFFERENTIAL DATA

Tetra Tech EM Inc.

2005-06-28 s:\cadd\elkton\elkton b-3.mxd TTEMI-NV andrew.dye